

Survival of crinoid stalk fragments and its taphonomic implications : discussion

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The recent paper by Oji and Amemiya (1998), apart from being an important and, perhaps, unexpected input to crinoid paleobiology, also makes a notable contribution to the ongoing debate concerning how major accumulations of crinoid-derived material (mainly fragments of stalks) are formed (for a recent review of such "regional encrinites", see Ausich, 1997). Kidwell and Brenchley (1994) specifically did not include analysis or detailed interpretation of such crinoid-rich beds in their assessment of the temporal patterns of variation shown by shell accumulations during the Phanerozoic. Regional encrinites are recognised to have patterns of accumulation that are somewhat different from shell beds that are dominated by, for example, brachiopods, bryozoans or benthic molluscs. The determination that lengths of crinoid stalk that have disarticulated from the 'parent' organism, for whatever reason, can survive presumably by the direct absorption of nutrients (as is known to occur in other, unmutated echinoderms; see Lawrence, 1987, for review) provides at least a partial explanation of why regional encrinites can be dominated by stalk fragments—that is, pluricolumnals—rather than a range of completely disarticulated ossicles from all parts of the skeleton.

The purpose of the present brief discussion is to provide data which support and supplement the observations and deductions of Oji and Amemiya (1998). Coincidentally, at about the same time that this paper was published, Donovan and Pawson (1998) described the rare occurrence in two extant species of the bourgueticrinid *Democrinus* of peculiar, root-like growths at the apex of the column (instead of a

crown) (Table 1). The interpretation of these bizarre structures is that such specimens were decapitated by predation, but the remaining stem continued to survive by direct absorption of nutrients and, indeed, sealed the broken end by new stereom calcite growth, in most examples also producing short, root-like outgrowths. Thus, there is excellent evidence for survival of the detached stem in at least one other group of extant, stalked crinoids. The notable difference between isocrinids (such as *Metacrinus rotundus* Carpenter; Oji and Amemiya, 1998) and bourgueticrinids is the mechanism of stem detachment. Unlike isocrinids, bourgueticrinids do not include regularly-spaced autotomy planes within their column and a crownless specimen is therefore most likely to be generated by predation or, speculatively, autotomy immediately beneath the crown where articulations are synostiosial or syzigial, rather than synarthrial (*Democrinus* stem morphology discussed by Donovan, 1997).

The different 'survival strategies' of the stalks in *Metacrinus* and *Democrinus* are probably related to the different functional morphologies of the column in isocrinids and bourgueticrinids. Oji and Amemiya (1998, p. 68) noted that "... there has been no record of apparent stalk regeneration in Recent stalked crinoids". However, such studies have concentrated on isocrinids, which have specialised articulations adapted for autotomy that are spaced regularly throughout the column (Emson and Wilkie, 1980). Autotomy at these articulations surely suggests that they are adapted to 'seal off' disarticulated lengths of column. I am not aware that an experimental study has ever observed what happens

Table 1. Locality data of 'regenerating', decapitated *Democrinus* spp. (based on Donovan and Pawson, 1998, appendix).

All specimens in the National Museum of Natural History, Smithsonian Institution (USNM).

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- USNM E11616. *Democrinus chuni* (Döderlein). South Atlantic Ocean, South Africa, Durban, 30°10'S, 32°9'E. 700 m. R/V ANTON BRUN. Identified by A.M. Clark.
 - USNM E18604. *Democrinus brevis* (A.H. Clark). North Atlantic Ocean, Caribbean Sea, Los Testigos Island, Venezuela. 11°34' 24"N, 62°10' 42"W. 597–598 m. R/V PILLSBURY. Identified by D.B. Macurda, Jr.
 - USNM E25870. *Democrinus brevis* (A.H. Clark). North Atlantic Ocean, Gulf of Mexico, Florida Keys, Straits of Florida. 24°14' 00"N, 82°56' 00"W. 641–686 m. R/V GERDA. Identified by D.L. Mayer.
 - USNM E41940. *Democrinus brevis* (A.H. Clark). North Atlantic Ocean, Gulf of Mexico, south of Louisiana Point, Louisiana. 27°24' 30"N, 93°17' 54"W. 576–732 m. R/V GYRE.
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if an isocrinid column is mechanically broken between autotomy planes, that is, in the middle of a noditaxis. Does it survive and can it seal the breakage with stereom? In *Democrinus*, which lacks autotomy planes, the column reacted to decapitation by regenerating at the apical end with all it 'knew' how to grow, that is, a root system. The same might be true of isocrinids if mechanically broken in mid-noditaxis position or, indeed, in any of the other groups of extant, stalked crinoid, none of which show particular adaptations to column autotomy.

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